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# Does Cognitive Impairment Predict Poor Self-Care in Patients with Heart Failure?

## Abstract

### Aims

Cognitive impairment occurs often in patients with chronic heart failure (CHF) and may contribute to sub-optimal self-care. This study aimed to test the impact of cognitive impairment on self-care.

### Methods and Results

In 93 consecutive patients hospitalized with CHF, self-care (Self-Care of Heart Failure Index) was assessed. Multiple regression analysis was used to test a model of variables hypothesized to predict self-care maintenance, management, and confidence. Variables in the model were mild cognitive impairment (MCI; Mini-Mental State Exam and Montreal Cognitive Assessment), depressive symptoms (Cardiac Depression Scale), age, gender, social isolation, education level, new diagnosis, and co-morbid illnesses. Sixty-eight patients (75%) were coded as having MCI and had significantly lower self-care management ( $\eta^2 = 0.07$ ,  $P < 0.01$ ) and self-confidence scores ( $\eta^2 = 0.05$ ,  $P < 0.05$ ). In multivariate analysis, MCI, co-morbidity index, and NYHA class III or IV explained 20% of the variance in self-care management ( $P < 0.01$ ); MCI made the largest contribution explaining 9% of the variance. Increasing age and symptoms of depression explained 13% of the variance in self-care confidence scores ( $P < 0.01$ ).

### Conclusion

Cognitive impairment, a hidden co-morbidity, may impede patients' ability to make appropriate self-care decisions. Screening for MCI may alert health professionals to those at greater risk of failed self-care.

## Keywords

self-care, heart failure, cognitive impairment

## Disciplines

Behavioral Medicine | Cardiology | Cardiovascular Diseases | Circulatory and Respiratory Physiology | Medical Humanities | Medicine and Health Sciences | Neurology | Nursing

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## ***Abstract***

***Aims:*** Cognitive impairment occurs often in patients with chronic heart failure (CHF) and may contribute to sub-optimal self-care. To test the impact cognitive impairment has on self-care.

***Methods and results:*** In 93 consecutive patients hospitalised with CHF, self-care (Self-Care of Heart Failure Index) was assessed. Multiple regression analysis was used to test a model of variables hypothesised to predict self-care maintenance, management and confidence. Variables in the model were mild cognitive impairment (Mini Mental State Exam and Montreal Cognitive Assessment), depressive symptoms (Cardiac Depression Scale), age, gender, social isolation, education level, new diagnosis and co-morbid illnesses. Three quarters (n=68) were coded as having mild cognitive impairment (MCI) and had significantly lower self-care management ( $\eta^2$  0.07,  $p<0.01$ ) and self-confidence scores ( $\eta^2$  0.05,  $p<0.05$ ). In multivariate analysis, MCI, co-morbidity index, NYHA class III or IV explained 20% of the variance in self-care management ( $p<0.01$ ); MCI made the largest contribution explaining 9% of the variance. Increasing age and symptoms of depression explained 13% of the variance in self-care confidence scores ( $p<0.01$ ).

***Conclusion:*** Cognitive impairment, a hidden co-morbidity, may impede patients' ability to make apt self-care decisions. Screening for MCI may alert health professionals to those at greater risk of failed self-care.

## Background

Chronic Heart Failure (CHF) is a significant problem affecting between 2.0% <sup>[1]</sup> and 4% <sup>[2]</sup> of the population in developed Nations. Older CHF patients have a 1.62-fold (95% confidence interval:1.48-1.79,  $p < 0.0001$ ) increased risk of diminishing cognitive functioning compared with age-matched controls <sup>[3]</sup>. The most likely aetiology for cognitive impairments in patients with CHF is inadequate cerebral perfusion and acute or chronic hypoxic brain damage <sup>[4]</sup>. Cognitive impairment is of concern as it is associated with relatively poorer health outcomes in those with CHF <sup>[5]</sup>. The occurrence of cognitive deficits can impair the ability to learn and carry out self-care. Structural changes of the brain can result in grey matter loss within the insular and cingulate cortex causing functional impairments relating to attention, memory, concentration, learning, executive functioning and psychomotor speed <sup>[6]</sup>. Deficits in memory and attention result in forgetfulness and poor learning ability which may impair treatment adherence <sup>[4, 7]</sup>. Furthermore, executive dysfunctions impair patients' ability to make decisions in complex situations, such as early recognition and interpretation of symptoms <sup>[6]</sup>. These cognitive impairments are likely to result in sub-optimal self-care.

Self-care can be defined as the process of engaging individuals to take responsibility for managing aspects of their health and adopting behaviours that prevent disease, limit illness and restore health <sup>[8]</sup>. Through active participation in their management, patients are empowered to have more control over their daily lives by purposely engaging in healthy behaviours, symptom monitoring and implementing a course of actions that can lessen debilitating symptoms from chronic illnesses <sup>[9, 10]</sup>. In patients with CHF, self-care includes actions such as adherence with medications and a low sodium diet; actions which are perceived to maintain clinical stability <sup>[11]</sup>.

The construct of CHF self-care can also be described as a naturalistic-decision-making process<sup>[12]</sup> as patients are encouraged not only to monitor symptoms for change on a daily basis but also to decide on an appropriate course of actions in a timely manner when symptom changes become apparent<sup>[12]</sup>.

It has been hypothesised that cognitive impairment may help to explain some of the self-care decision-making problems seen in persons with CHF<sup>[6]</sup>. Yet few researchers have set out to examine differences in self-care between CHF patients with and without mild cognitive impairment (MCI); a classification referring to subtle cognitive deficits that do not meet the criteria for dementia<sup>[13]</sup>. Previously we developed and tested a conceptual model that identifies a number of factors related to the phenomena of CHF self-care<sup>[14]</sup>. The factors included in the model were: Age; Gender; Co-morbidity; Social support; Depressive symptoms using the Cardiac Depression Scale<sup>[15]</sup>; Cognitive function using the Mini Mental State Exam<sup>[16]</sup>. Cognitive impairment added to our model but did not appear to be a significant predictor of self-care, which may have been explained by using only the Mini-Mental State Exam (MMSE) to screen for MCI. This study re-examines the conceptual model as a method for screening a number of factors that may impair self-care and includes the Montreal Cognitive Assessment (MoCA)<sup>[17]</sup> as an additional screening measure of cognitive function. The MoCA measures a number of different cognitive domains than the MMSE, including executive functioning, a higher order cognitive domain required to construct and execute effective plans of action<sup>[18]</sup>.

## **Study Objective**

The objective of the study was to determine if mild cognitive impairment was a significant predictor of self-care in patients with CHF older than 45 years of age.

## **Methods**

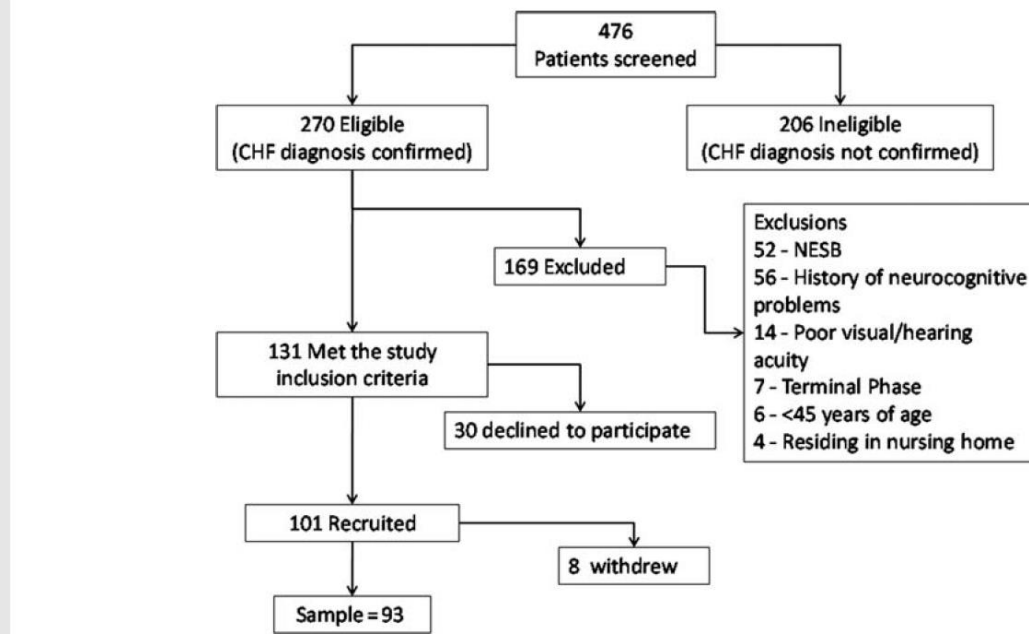
### **Study setting**

The participants were patients referred to a Chronic Heart Failure Management Program (CHF-MP) at two metropolitan health networks in Victoria, Australia. Assessment of cognitive function, depressive symptoms, and self-care behaviours was undertaken by the primary researcher (JC) through administration of questionnaires during the patient's hospital admission.

### **Study Sample**

Between April 2007 and September 2008, patients referred to the hospital CHF case manager, were screened for study eligibility. The inclusion criteria for the study were a diagnosis of CHF using the clinical criteria from Australian Best Practice Guidelines,<sup>[19]</sup> evidence of cardiac dysfunction recorded on an echocardiogram report, and age 45 years and over. Patients were excluded from the study on the following basis: Neurological problems documented in the medical history (cerebral vascular accident, transitional ischemic attack, short-term memory loss or dementia); residing in a residential nursing home; and inability to answer questionnaires independently due to language barriers. Patients who met the inclusion criteria were approached by the CHF case manager to participate in the study and then referred to the researcher.

Four hundred and seventy-six patients admitted to hospital with a provisional diagnosis of heart failure were screened but in 206 cases the diagnosis was not confirmed. Of the 270 eligible patients with a confirmed diagnosis of CHF, 169 (63%) were excluded (see Figure 2). Reasons for exclusion were: 52 (19%) did not have English as their primary language, 56 (21%) were excluded because they had a history of neurological events, 14 (5%) had poor visual/hearing acuity that was a barrier from completing questionnaires independently, 7 (3%) were deemed to be in the terminal phase of CHF, 6 (2%) were <45 years of age, 4 were residing in a high level supported accommodation. One-hundred and thirty patients met the study inclusion and were approached. Thirty patients (11%) declined to participate because they felt too unwell and the study would be too burdensome. Informed consent was gained from 101 patients; however eight later requested to withdraw. Participants enrolled in the study were significantly younger than those excluded ( $73\pm11$  vs.  $76\pm13$  yrs,  $Z=-3.5$ ,  $p<0.001$ ) but there were no significant gender differences between the two groups ( $p=0.08$ ).



**Figure 1** Sample selection. NESB, Non-English-Speaking Background.

## Procedure

Patient interviews were conducted 6 days (SD  $\pm 5$ ) after hospital admission, when they were clinically stable, not unduly fatigued and usually while they were still hospitalised. Administered at the time of the interview were instruments used to measure: CHF self-care (Self-Care of Failure Heart Index <sup>[20]</sup>); Cognitive function (Mini Mental State Exam <sup>[16]</sup> & Montreal Cognitive Assessment <sup>[17]</sup>); Depressive symptoms (Cardiac Depression Scale <sup>[15]</sup>). Descriptive data collected from the medical history included: age, gender, social situation, Charlson co-morbidity index <sup>[21]</sup>, NYHA functional class, experienced with CHF diagnosis (>2months), level of education, medications, blood pressure and blood pathology.



## ***Tools***

### **Self-care Heart Failure Index**

The Self-Care of Failure Heart Index (SCHFI) was developed to measure adherence to recommended CHF self-care behaviours, patients' decision making abilities regarding their symptoms, and self-care confidence <sup>[20]</sup>. Specifically three scales reflect self-care maintenance, self-care management and self-care self-confidence <sup>[20]</sup>. Each domain is associated with different behaviours and skill sets. Self-care maintenance reflects those behaviours performed to maintain a stable state (e.g., daily weight monitoring, taking medications as prescribed, and eating a low sodium diet). Self-care management reflects the decision-making process involved in recognising changes in symptoms, evaluating the importance of that change, implementing remedies, and evaluating treatment effectiveness. Self-care confidence reflects one's confidence in the ability to perform self-care. These three scales are typically found to correlate moderately (in the range of  $r=.5$ ) <sup>[22]</sup>. In this study, the correlations among the 3 scales ranged from .14 to .41. According to Riegel & Dickson <sup>[12]</sup>, maintenance and management reflect CHF self-care, and confidence scores should be used to explain why some patients master self-care and others do not. Responses from each of these self-care scales are transformed to a 0-100 scale score; higher scores reflect superior self-care. Scale scores  $\geq 70$  are considered to reflect adequate self-care <sup>[23]</sup>. Psychometric testing of the SCHFI in 760 patients with CHF demonstrated adequate internal consistency of the self-care scales: self-care management (Cronbach's  $\alpha$ .70); and self-care self-confidence (Cronbach's  $\alpha$ . 82). Low reliability for the self-care maintenance scale (Cronbach's  $\alpha$ . = .55) was found by the instrument authors, which was explained by knowing that the behaviours reflected in the scale are

largely independent<sup>[20]</sup>. The SCHFI has been used in diverse populations and has been shown to be sensitive to detect changes in self-care<sup>[24]</sup>.

### **Mini Mental State Examination**

The Mini Mental State Examination (MMSE)<sup>[16]</sup>, is widely used as a dementia screening measure that estimates the severity of cognitive impairment. A significant advantage of this tool is that it can readily be used in the clinical setting by nurses or allied health professionals, taking only five to ten minutes to complete. The MMSE consists of 30 questions that screen for orientation, short-term memory, concentration and visual spatial skills. As a measure of cognitive dysfunction the MMSE has been shown to have moderate to satisfactory internal reliability ( $\alpha=0.68$  to  $0.96$ ). The sensitivity and specificity of the MMSE in identifying moderate-to-severe cognitive impairment is high but the specificity of detecting mild degrees of impairment are low<sup>[25]</sup>. Although it is recognised that the sensitivity of the MMSE in detecting MCI is low<sup>[17]</sup> cut-off scores of 26/27 have been shown to be of prognostic importance<sup>[5]</sup>. Guidelines for the clinical administration of MMSE suggest using scores 21-26 to indicate MCI, which led to a decision to use 26/27 in this study to ensure capturing of less severe cognitive impairment.

### **Montreal Cognitive Assessment**

The Montreal Cognitive Assessment (MoCA) was developed as a brief screening tool to detect MCI<sup>[17]</sup>. The MoCA assesses the cognitive domains of: attention and concentration, executive functions, memory, language, visuoconstructional skills, conceptual thinking, calculations and orientation<sup>[17]</sup>. In Comparison to MMSE, the MoCA uses more words in assessing memory, has fewer learning trials and a longer delay before testing memory recall. Three tasks assess differing aspects of executive functions: an alternation task adapted from the trail making B task, a

phonemic fluency task, a verbal abstraction task. Total possible score is 30 and MCI is indicated by cut-off <26. Low educational attainment is corrected by adding 1-point to the final score for <12 years of education. In the instrument development study <sup>[17]</sup> the MoCA had higher sensitivity compared with MMSE at detecting MCI (90% vs 18%, respectively). The specificity of the MoCA compared with MMSE was 87% vs 100%. Several other studies <sup>[26, 27]</sup> have also reported the MoCA has superior sensitivity with good specificity in comparison to the MMSE when screening for MCI; for this reason the Canadian Stroke Strategy now recommends using the MoCA over the MMSE in screening for vascular cognitive impairments <sup>[28]</sup>.

### **Cardiac Depression Scale**

The Cardiac Depression Scale (CDS) <sup>[15]</sup>, developed in Australia where this study took place, is a psychometrically sound measure of depressed mood within cardiac populations. It was purposefully developed because depression in cardiac patients does not always fulfil the criteria for depression DSM-III-R; instead it often resembles an adjustment disorder or grief reaction. Furthermore, most other measures of depression have been developed in psychiatric patients (producing a skewed distribution in cardiac patients) or contain only a small amount of information necessary to assess the degree of depressed mood specifically in cardiac populations <sup>[15]</sup>. The instrument is made up of 26 items with 7 subscales (sleep, anhedonia, uncertainty, mood, cognition, hopelessness, inactivity). A seven-point response scale is used for each item, with positive items reverse scored. In instrument testing in a sample of CHF patients, 37% scored >100, a cut-off thought to indicate severe depressive symptoms. Psychometric analysis of the scale as well as correlation with other general depression measures has demonstrated its internal consistency and its validity <sup>[15]</sup>. Testing in a sample of 141 cardiac patients <sup>[29]</sup> demonstrated that a

cut-off score  $\geq 84$  had the same specificity as Beck's Depression Inventory cut-score of  $\geq 9$  but had statistically superior sensitivity (97% vs 84%  $p=0.004$ ). This cut-off score was used in our study to identify the presence of any depressive symptoms.

### **Charlson co-morbidity index**

The severity of co-morbid conditions was assessed using the Charlson Co-morbidity Index, which classifies co-morbidity based on the number and seriousness of co-morbid diseases. The weighted index of co-morbidity has proven to be a significant predictor of 1-year survival with higher scores indicating greater risk of death <sup>[21]</sup>. Most diseases are assigned an index of 1 but more severe conditions are given a weighted score of 2, 3 or 6. In this study, all participants had a score of at least 1 because everyone had CHF. Overall index scores can be categorized as mild, moderate or severe co-morbidity.

### ***Ethical considerations***

The study was approved by both the relevant area Health Network Research Committee and the University Human Research Ethics Committee and conforms to the principles outlined in the Declaration of Helsinki.

### ***Data management and statistical analyses***

Continuous data are presented as the mean  $\pm$  standard deviation, except that skewed variables are presented as the median and interquartile range (IQR). Categorical data are presented as percentages with 95% confidence intervals (CI) presented where appropriate. To compare patient groups according to demographic and clinical profile, we used Chi Square ( $\chi^2$ ) analysis and

calculated the odds ratios (OR) and 95% CI for discrete variables, and Student's t-test and analysis of variance for continuous variables.

Three multiple regression analyses were performed using a backward method to determine which independent variables (age, gender, MCI on either screening measure, absence of depressed mood, living with support, co-morbid index, Functional class NYHA class, completed < 12yrs education, and new diagnosis) were predictors of self-care maintenance, management and self confidence scores. To make the interpretation of the findings relevant to clinical practice dichotomised data was used for the following variables: MCI, depressive symptoms, living with support, completed <12yrs education. Multicollinearity was checked for each regression model and the assumptions were not violated. Significance was defined at the two-sided 0.05 level. SPSS (version 12.0.1 for Windows, Chicago, IL) was used for analyses and an online Power/sample size calculator used for power calculations (<http://www.danielsoper.com/statcalc/calc17.aspx>). Allowing for nine predictor variables and an effect size of  $R^2 = 0.20$  a sample size of 93 had 83% power ( $p=0.05$ ) to detect an 8-point difference in mean self-care scores.

## Results

Overall the group were elderly (mean age  $70 \pm 11$  years), predominantly male, functionally compromised, had several co-existing co-morbidities, almost half were living alone and few patients had an absence of depressive symptoms (See Table 1). The majority of patients had been prescribed pharmacotherapy considered gold standard in the treatment of CHF <sup>[2]</sup>.

**Table 1 Clinical and demographic characteristics of the sample**

<b>Socio demographics</b>	<b>n (%)</b>
Female	27 (29%)
Living Alone	39 (42%)
Did not complete 12 years education	72 (77%)
Retired	75 (81%)
Clinical data	
New diagnosis	28 (30%)
NYHA 3	42 (45%)
NYHA 4	5 (5%)
Hypotensive, BP < 100 systolic	13 (14%)
Renal Impairment, serum creatinine > 120 $\mu$ mol/L	50 (54%)
Anaemic, serum Hb < 100 g/L	18 (19%)
History of ischaemic heart disease	55 (59%)
Not diabetic	52 (56%)
Smoking history	78 (84%)
Co-morbid index low	35 (38%)
Co-morbid index medium	40 (43%)
Co-morbid index high	18 (19%)
Either on ACEI or ARB	78 (84%)
Prescribed diuretic	90 (97%)
Prescribed aldosterone antagonist	31 (33%)
Prescribed beta blocker	79 (85%)
Depressive symptoms	68 (73%)
CHF self-care	
Adequate self-care maintenance	49 (53%)
Adequate self-care management	25 (27%)
Adequate self-care confidence	41 (44%)

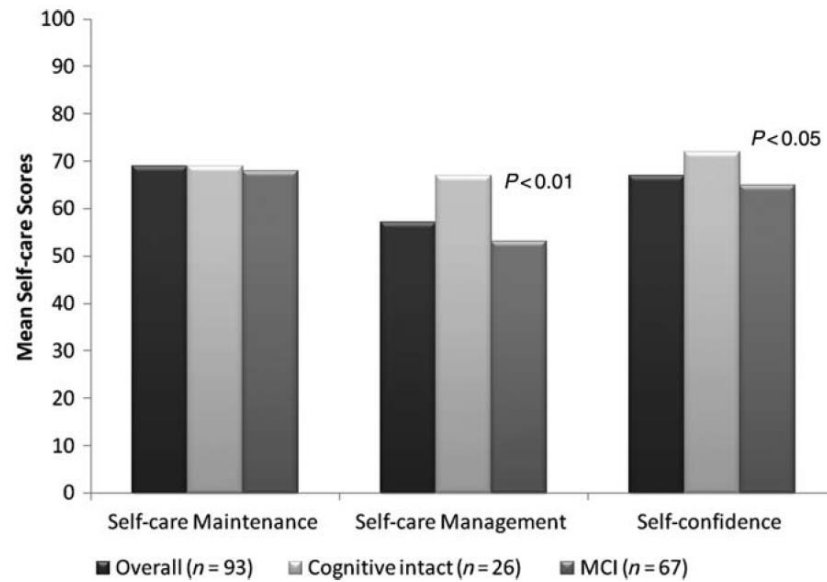
NYHA, New York Heart Association classification; ACEI, Angiotensin Converting Enzyme Inhibitor; ARB, Angiotensin II Receptor Antagonists.

### ***Cognitive Function for the group***

Twenty-five (27%, 95% CI 19% to 38%) patients had normal cognitive function on both MMSE and MoCA. Sixty eight (73%, 95% CI 65% to 83%) were coded as having mild but potentially significant cognitive impairments (MCI) from the screening measures. Only 1 person scored <27 solely on the MMSE. Thirty-one (33%) had scores below the threshold for MCI on both MoCA and MMSE and 36 (39%) had scores <26 only on the MoCA but >27 on MMSE.

### ***Self-care behaviours for the group***

In this sample, all patients reported symptoms of breathlessness or oedema in the previous month, allowing for computation of scores for all three self-care domains. Self-care scores were normally distributed ( $D > 0.05$ ) but overall scores were low across the group. Less than half (44%) had adequate self-care maintenance and confidence scores and less than a third (27%) had adequate self-care management scores (Figure 3). There was no significant difference in mean self-care maintenance scores between patients with and without cognitive impairment ( $t(91) = 0.09$ ,  $p=0.93$ ). In contrast, patients coded as MCI on average had lower scores on self-care management ( $53.3 \pm 19.5$  vs.  $65.4 \pm 18.0$ ;  $t(91) = 2.7$ ,  $p \leq 0.01$ ) and self-care confidence ( $64.7 \pm 15.4$  vs.  $72.1 \pm 14.8$ ;  $t(91) = 2.4$ ,  $p < 0.02$ ) and the magnitude in the differences in mean scores was moderate ( $\eta^2 0.07$  and  $\eta^2 0.05$ , respectively). Fifty-one (76%) patients with inadequate self-care management were coded as MCI (OR 1.27, 95% CI 0.9 to 1.8, LR = 0.13). Patients with MCI were 30% more likely to have inadequate self-care confidence (OR 1.33, 95% CI 1.1 to 1.75, LR = 0.04).



**Figure 2** Self-care behaviours in heart failure patients with or without cognitive impairments. Mean self-care scores for each domain (maintenance, management, and confidence) of the Self-Care of Failure Heart Index for the sample overall, for patients coded as cognitively intact and for patients coded as mild cognitive impairment (MCI). Score >70 on any domain was considered adequate self-care.

### Independent predictors of self-care

Multivariate regression was performed to assess the impact of a number of factors on self-care maintenance, management and confidence scores (Table 3). In multivariate analysis the correlations between each independent variable was <0.7 (See Table 2). When self-care maintenance was regressed, experience with CHF (diagnosis >2 months) was the most significant variable and explained 10% of the variance in self-care maintenance scores ( $p<0.01$ ).



**Table 2** Correlations between independent variables in the multivariate analysis

	Age	Gender	Lives with support	<12 years education	Diagnosis ≤2 or >2 months	NYHA class	Charlson co-morbidity index	Depressive symptoms	MCI
Self-care maintenance score	0.12	0.15	0.03	-0.04	0.31	0.07	0.088	-0.12	-0.04
Self-care management score	-0.21	-0.08	0.09	0.03	0.17	0.26	0.24	0.02	-0.32
Self-care confidence score	-0.25	-0.15	0.02	0.08	0.06	-0.15	-0.01	-0.23	-0.21
Age	1.00	0.10	-0.01	-0.06	0.02	-0.16	0.06	-0.12	0.26
Gender	0.10	1.00	-0.08	-0.12	0.11	0.20	0.12	0.04	0.08
Lives with support	-0.01	-0.08	1.00	0.20	-0.13	-0.07	0.03	-0.19	-0.09
<12 years education	-0.06	-0.12	0.20	1.00	-0.04	-0.10	-0.12	-0.13	0.05
Diagnosis ≤2 or >2 months	0.02	0.11	-0.13	-0.04	1.00	0.25	0.24	0.10	-0.20
NYHA class	-0.16	0.20	-0.07	-0.10	0.25	1.00	0.16	0.27	-0.08
Charlson co-morbidity index	0.06	0.12	0.03	-0.12	0.24	0.16	1.00	0.08	-0.05
Depressive symptoms	-0.12	0.04	-0.19	-0.13	0.10	0.27	0.08	1.00	0.15
MCI	0.26	0.08	-0.09	0.05	-0.20	-0.08	-0.05	0.15	1.00

MCI, mild cognitive impairment.

In univariate analysis MCI moderately correlated with self-care management scores ( $r=-0.32$ ,  $p=0.001$ ). In multivariate regression NYHA class III or IV, Co-morbidity Index and MCI explained 20% of the variance in self-care management score ( $p<0.01$ ); MCI made the largest contribution to the model explaining 9% of the variance in self-care management.

In univariate analysis there were low-moderate correlations between self-care self-confidence scores and MCI ( $r=-0.21$ ,  $p=0.02$ ), age ( $r=-0.25$ ,  $p<0.01$ ) and depressive symptoms ( $r=-0.23$ ,  $p<0.02$ ). In multivariate analysis however, only younger age and absence of depressive symptoms were significant variables, explaining 13% of the variance in self-care confidence scores ( $p<0.01$ ).

**Table 3** Regression models for self-care

Model	Predictor variables	Standardized coefficients beta	Partial correlations	Sig.	F	P	R <sup>2</sup>
Self-care maintenance	Experience with CHF	0.31	0.31	<0.01	9.6	<0.01	0.10
Self-care management	NYHA class	0.19	0.20	0.04	5.9	<0.01	0.17
	Charlson co-morbid index	0.21	0.23	0.05			
	MCI	−0.25	−0.27	<0.01			
Self-care confidence	Age	−0.22	−0.23	0.03	7.43	<0.01	0.14
	Depressive symptoms	−0.28	−0.29	<0.01			

## Discussion

In this study we found three-quarters (73%) of a sample of CHF patients chosen because they were *without* a history of neurocognitive problems actually had unrecognised cognitive impairments.

Our results indicate that CHF patients who have mild cognitive dysfunction are as likely as cognitively intact patients to follow recommended self-care maintenance behaviours such as daily weighing. Conversely, patients with MCI were 30% more likely than patients cognitively intact to have inadequate self-care confidence. Although more patients with MCI had inadequate self-care management than patients cognitively intact, this did not reach statistical significance.

Nonetheless, in multivariate analysis it was MCI that made the strongest contribution to predicting self-care management. The findings from this study suggests that mild cognitive dysfunction plays a role in predicting patient's ability to independently recognise symptom changes and make appropriate self-care decisions. Unless purposefully screened for, MCI is largely hidden and can help to explain why it is difficult for many patients to develop adequate level of self-care skills. In the long-term, poor self-care has notable clinical ramifications<sup>[30]</sup> and targeted strategies are required to improve this outcome.

Other researchers [31, 32] have found that a delay in symptom recognition and initiation of self-care actions potentially increases the risk of hospital admission or premature death. Furthermore,

optimal self-care practices are hypothesised to contribute to physiological stabilisation and retard the progression of cardiac dysfunction resulting in improved health outcomes <sup>[30]</sup>. We previously found <sup>[5]</sup> over a five year period, that patients that patients with MCI had a 1.4-fold increased risk of being admitted to hospital or death ( $p=0.002$ ), relative to cognitively intact patients and after adjusting for potential confounders. Despite receiving gold-standard treatments from a home-based nursing intervention, patients with MCI had a two-fold increased risk of death ( $p=0.03$ ) compared with those with normal cognitive functioning. Potentially, cognitive impairment resulted in neural processing problems impacting on the ability of patients to remember and learn self-care skills, ultimately blocking the beneficial effects of a home-based nursing intervention <sup>[5]</sup>.

It has been recognised that patients with CHF are at an increased risk of developing cognitive issues that potentially will progress to dementia or Alzheimer's disease <sup>[33]</sup>. The most likely reason for the development of cognitive impairment in this group of patients is the result of inadequate cerebral perfusion and acute or chronic hypoxic brain damage <sup>[4, 6]</sup>. Other variables that also appear to contribute to the development of cognitive impairment in patients with CHF include age, co-morbidity, hypertension, depression and medications <sup>[4]</sup>.

Structural changes in the brain <sup>[6]</sup> may explain why attention, memory, concentration, learning, executive functioning and psychomotor speed are the most common cognitive domains impaired in patients with CHF <sup>[34]</sup>. According to Dickson, Tkacs & Riegel <sup>[6]</sup> deficits in memory and attention may result in forgetfulness and poor learning ability, marring treatment adherence. In contrast neural processing deficits may be the consequence of executive dysfunction, resulting in prolonged time to construct self-care decisions and difficulty in foreseeing the consequences of

actions taken, or not taken <sup>[6]</sup>. Depression has also been shown to impact on a number of cognitive domains including processing speed and executive functions <sup>[35]</sup>.

It is therefore possible that in this study, depressive symptoms which occurred in nearly three-quarters of the group, mediated the cognitive impairments identified and may help to explain why MCI was found to be the most significant predictor of self-care management. Conversely there is a growing body of evidence that patients with CHF have structural brain injury occurring in areas involved with autonomic, pain, mood, language, and cognitive function <sup>[36]</sup>. This would suggest that neural brain injury associated with the CHF may in itself contribute to the onset of depression that so often accompanies this syndrome.

Nearly three-quarters of our group had evidence of depressive symptoms. Other studies that have screened for depressive symptoms have also identified the prevalence of this co-morbidity ranges between 24-85% <sup>[37]</sup>. In contrast the prevalence of major depression is somewhat lower with only around one-quarter of patients with CHF being diagnosed with this co-morbidity <sup>[37]</sup>. It is possible that the method chosen to screen for depressive symptoms may have resulted in an over-estimation as to the presence of this psychiatric co-morbidity. The CDS contains a number of items that assess somatic symptoms of sleep disturbance which is also a somatic burden of CHF.

However, in one study comparing the depression profile in patients with and without CHF <sup>[38]</sup> both groups reported similar somatic symptoms. In contrast patients with CHF had fewer cognitive-emotional features of depression. Together these findings not only support our decision to use the CDS in screening for depressive symptoms but also the need to screen for both cognitive impairment and depressive symptoms as barriers to self-care.

Other factors that appeared to predict better self-care included: experience with CHF, NYHA class, co-morbidity, younger age, and absence of depressive symptoms. Although these factors were significant in our models there remains a large variance in self-care that is still unexplained and further research is required to identify other issues. For example, fatigue which is a cardinal symptom of CHF, may overlap with variables identified in the study. Others have shown that there is a strong correlation between emotional distress and fatigue that can have dire consequences on quality of life and adherence with self-care behaviours<sup>[39]</sup>. Whilst fatigue was not directly measured in this study it needs to be considered and further research is required to examine its impact on self-care.

Other researchers<sup>[40-42]</sup> have proposed that there are a multitude of factors that impede patients' ability to undertake self-care decisions and actions, including the interplay between concomitant co-morbidities associated with CHF and impairments associated with aging. This indicates the need for further research taking into consideration the complexity these inter-related factors in applying educational strategies to individual need.

Mild cognitive impairment which appears to be a frequent and hidden co-morbidity in patients with CHF should be considered when developing an education plan directed at enhancing self-care behaviours. In examining the incorrect responses amongst those patients coded as MCI, it was found they had errors in three cognitive domains identified by both the MMSE and MoCA: language, memory recall and orientation. In contrast, errors in concentration, visuo-spatial and executive functions were identified by the MoCA alone. These cognitive domains are not only important for learning, planning, executing and foreseeing the consequences of decisions and actions in complex situations<sup>[6]</sup> but are essential in self-care. This suggests the MoCA is more

selective and sensitive over the MMSE, in identifying patients with cognitive impairments that have potential ramifications on their ability to make self-care decisions. Studies investigating subtle cognitive impairments in other chronic diseases<sup>[43, 44]</sup> have indicated the MoCA is more sensitive than the MMSE at detecting this co-morbidity. For this reason, the MoCA is now the recommended tool in screening for vascular cognitive impairments<sup>[28]</sup>. Nonetheless, the MoCA is only a screening tool and if MCI persists then further assessment of cognitive function from a full battery of neuropsychological tests may be required. The next stage of this research program is to apply in clinical practice the conceptual model tested, henceforth named the InCOGNITO conceptual model to reflect the hidden nature of this co-morbidity, and to develop an algorithm of educational strategies according to risk of inadequate self-care and individual need.

### ***Limitations***

This study was conducted in a selective sample of mainly male patients with CHF and due to the inclusion criteria had to be able to independently answer questionnaires. Our results may not truly represent self-care practices in more general and diverse CHF populations. While CHF affects women as much as men, females represented only 29% of this sample limiting the generalisability of our findings. There was no gender difference between patients excluded from the study and those recruited, suggesting this was more likely to reflect the clinical practice of elderly patients not receiving an in-patient echo to confirm the diagnosis of CHF.

The use of self-report measures of self-care may have resulted in socially desirable responses for patients who had been participating in a heart failure management program. If this was the case, then genuine self-care practices were masked and may potentially have been worse than that reported. Self-care was measured during the acute in-patient admission when patients were

potentially most vulnerable and perhaps even sleep deprived. Other studies <sup>[45]</sup> have acknowledged that these factors can overwhelm patients and render education ineffective. This time point however was purposefully chosen because it is often during this phase that patients are recruited to heart failure management programs and it is often problematic in terms of deciding who would most benefit from patient education and support. Further research is required to describe how these cognitive impairments impede self-care decision-making process over a longer-time frame.

### ***Conclusion***

Our study adds to the body of evidence that for many patients with CHF, self-care decisions and skills are not easy to learn. Mild cognitive dysfunction is often a hidden co-morbidity and may help to explain the difficulties patients with CHF have in mastering self-care management. The use of screening measures to identify this co-morbidity may alert health professionals to those at greater risk of failed self-care. In this manner, identifying patients with mild cognitive impairment may help in the application of patient education and support strategies to individual need, culminating in a more cost effective use of limited resources.

### **Author Contributions**

JC, LWC and SS were responsible for the study conception and design. JC, LWC, BR, KP and SS were responsible for the drafting of the manuscript. JC performed the data collection. JC, SKL, LWC, SS, KP, BR were responsible for data analysis and interpretation. LWC, KP, BR, SK, and SS made critical revisions to the paper. LWC , KP and SS supervised the study.

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